Study Notes and Questions on

Mathematics – Pedagogy for CTET and TETs

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Introduction

CTET Mathematics include two important sections, CONTENT & PEDAGOGY and 50% questions are based on Pedagogy. The purpose of this eBook is to provide you quick revision notes on Mathematics Pedagogy. We have also provided questions from previous year's exams to help you understand type of questions being asked on this topic.

We hope you find this useful. All the best for your exam.
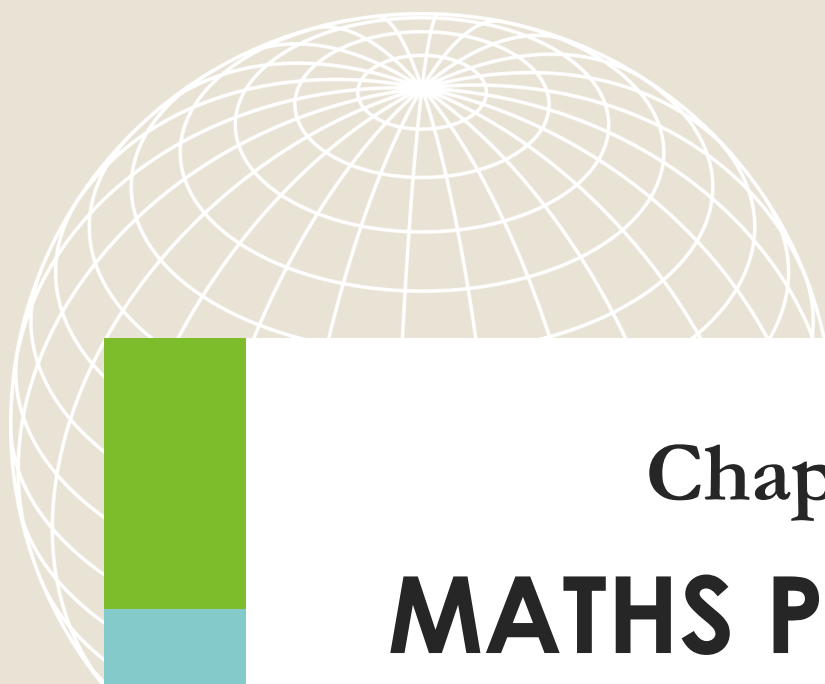
Chapter One

MATHS PEDAGOGY SYLLABUS

Maths Pedagogy Syllabus

- Nature of Mathematics/Logical thinking; understanding children's thinking and reasoning patterns and strategies of making meaning and learning
- Place of Mathematics in Curriculum
- Language of Mathematics
- Community Mathematics
- Evaluation through formal and informal methods
- Problems of Teaching
- Error analysis and related aspects of learning and teaching
- Diagnostic and Remedial Teaching
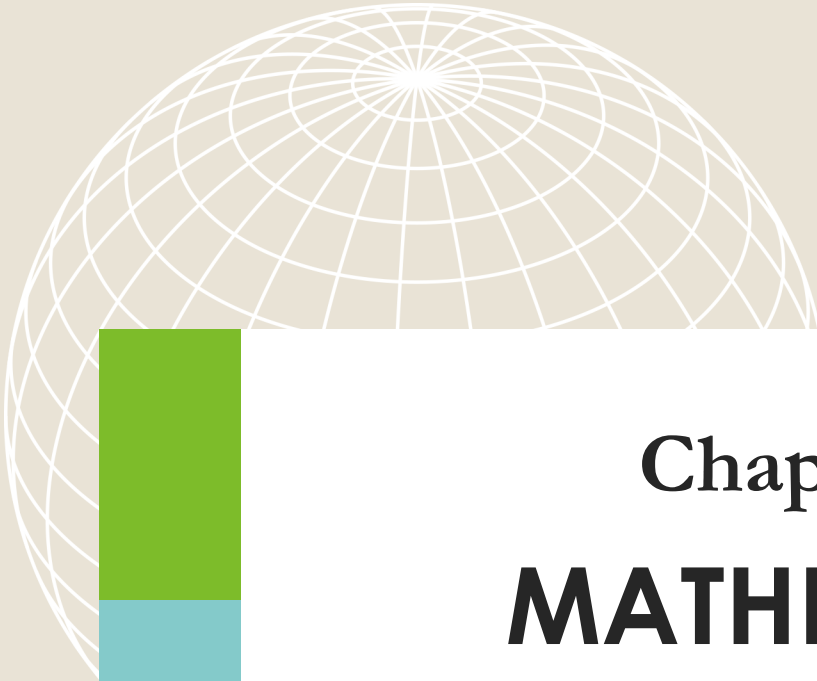
Chapter Two

MATHEMATICS PEDAGOGY

Mathematics Pedagogy

Mathematics is a subject that finds application in every walk of our life. Knowingly or unknowingly, people use concepts of Mathematics in their daily life. Considering the relevance of Mathematics, it is treated as one of the basic and compulsory subjects in school curriculum. A successful teacher of Mathematics should have profound knowledge of nature and theoretical concepts in Mathematics so as to help children in effective learning.

Teaching of mathematics in the class is not only concerned with the computational knowledge of the subject but is also concerned with the selection of the mathematical content and communication leading to its understanding and application. So while teaching mathematics one should use the teaching methods, strategies and pedagogic resources that are much more fruitful in gaining adequate responses from the students than we have ever had in the past.

We know that the teaching and learning of mathematics is a complex activity and many factors determine the success of this activity. The nature and quality of instructional material, the presentation of content, the pedagogic skills of the teacher, the learning environment, the motivation of the students are all important and must be kept in view in any effort to ensure quality in teaching-learning of mathematics.

Mathematics is a science that involves dealing with numbers, different kinds of calculations, measurement of shapes and structures, organization and interpretation of data and establishing relationship among variables, etc.

Mathematics is a study of patterns, numbers, geometrical objects, data and chance. It is a diverse discipline that deals with data analysis, integration of various fields of knowledge, involves proofs, deductive and inductive reasoning and generalizations, gives explanation of natural phenomena and human behavior. Mathematics also helps to understand the world around us by exploring the hidden patterns in a systematic and organized manner; and it has universal applicability

1) Nature of Mathematics

Mathematics relies on both logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. The nature of Mathematics includes mathematical ideas progress from concrete to abstract; grow from particular to general and its knowledge is conceptual as well as procedural. Similarly, in Mathematics we come across 'definitions' that describe concepts; 'examples' to illustrate procedures; 'theorems' to state valid results; conjecture' that talks about mathematical statements for which proofs are to be worked out but which seem plausible, and 'counter example' to disprove statements.

The nature/characteristic of mathematics can be also discussed in terms of:

Mathematics is the "**queen of all sciences**" and its presence is there in all the subjects. Mathematics acts as the basis and structure of other subjects. These views have brought in relevance of Mathematics to be considered as one of the core subjects of school curriculum.

Mathematics is more than computation. Mathematics gives us clear and correct answers through calculations.

Science of logical reasoning: In mathematics the results are developed through a process of reasoning. Reasoning in mathematics possesses a number of characteristics such as, Simplicity, Accuracy, Certainty of Results, Originality and Verification. Conclusions follow naturally from the facts when logical reasoning is applied to the facts.

Abstractness: Mathematical thinking often begins with the process of abstraction—that is, noticing a similarity between two or more objects or events. Aspects that they have in common, whether concrete or hypothetical, can be represented by symbols such as numbers, letters, other marks, diagrams, geometrical constructions, or even words.

Mathematical Language and Symbolism: It has its own unique language and symbols. Mathematical language and symbols cut down on lengthy statements. Helps in the expression of ideas and concepts in exact form. It is free from verbosity, helps to point out clear and exact expression of facts.

Mathematics is classified broadly into two types, which are given below:

Pure Mathematics: A study of the basic concepts and structures for the purpose of a deeper understanding of the subject. Pure Mathematics deals with the basic information/facts of Mathematics where various concepts, proofs and theories, etc. are discussed. For example, the theoretical knowledge concerning arithmetical operations such as addition, subtraction, multiplication and division are part of it.

Applied Mathematics: Applied mathematics is an abstract science of numbers, quantity and space as applied to other disciplines such as Physics and Engineering. The Pure Mathematics when utilized to solve different problems either mathematical or life is termed as applied Mathematics. For example, children study the concept of 'addition' which is explored while buying food items from a grocery shop' the concept of 'interest' is used to calculate the interest on money deposited in banks, etc.

2) Place of Mathematics in Curriculum

Curriculum includes all those activities, experiences and environment which the child receives during his educational career under the guidance of educational authorities.

The major reform in curriculum for all stages of school education came after National Policy of School Education, 1968 as per the report of the 'Kothari' commission. A common curriculum for class I to class X was prepared at national level for adoption by all the states in the country with adjustments according to local need. Then the 10+2+3 pattern was adopted in the country. Mathematics and Science was made compulsory core subject at Middle and Secondary stage. Mathematics and Science were greater stressed. Accordingly General Mathematics was compulsory subject up to class X and at Secondary level an advance Mathematics was there as optional subject.

General Mathematics comprises Arithmetics, Geometry (concept and theory) a simple Algebra.

Advance Mathematics mainly consists of integers, quadratic equation, logarithm, coordinate geometry.

Aims of Teaching Mathematics in the School.
- To develop the mathematical skills like speed, accuracy, neatness, brevity, estimation, etc. among the students.
- To develop their logical thinking, reasoning power, analytical thinking, critical thinking.
- To develop their power of decision-making.
- To develop the technique of problem solving.
- To recognize the adequacy or inadequacy of given data in relation to any problem on individual basis.
- To develop their scientific attitude i.e. to estimate, find and verify results.
- To develop their ability to analyze, to draw inferences and to generalize from the collected data and evidences.
- To develop their heuristic attitude and to discover solutions and proofs with their own independent efforts.
- To develop their mathematical perspective and outlook for observing the realm of nature and society.

3) Language of Mathematics

The language of mathematics is the system used by mathematicians to communicate mathematical ideas among themselves. This language consists of a substrate of some natural language (for example English) using technical terms and grammatical conventions that are peculiar to mathematical discourse (see Mathematical jargon), supplemented by a highly specialized symbolic notation for mathematical formulas.

In order to be considered a language, a system of communication must have vocabulary, grammar, syntax, and people who use and understand it. Mathematics meets this definition of a language. Math is a universal language. The symbols and organization to form equations are the same in every country of the world. The vocabulary of math draws from many different alphabets and includes symbols unique to math.

A mathematical equation may be stated in words to form a sentence that has a noun and verb, just like a sentence in a spoken language. For example: 3 + 5 = 8 could be stated as, "Three added to five equals eight."

Breaking this down, nouns in math include:

Arabic numerals (0, 5, 123.7), Fractions (1⁄4, 5⁄9, 2 1⁄3), Variables (a, b, c, x, y, z) Expressions (3x, x2, 4 + x), Diagrams or visual elements (circle, angle, triangle, tensor, matrix), Infinity (∞), Pi (π), Imaginary numbers (i, -i), The speed of light (c)

Verbs include symbols including:

Equalities or inequalities (=, <, >), Actions such as addition, subtraction, multiplication, and division (+, -, x or *, ÷ or /), Other operations (sin, cos, tan, sec)

3) Community Mathematics

Mathematics is subject of great social importance. It helps in proper organisation and maintenance of our social structure. Society is the result of the union of individuals. It needs various laws, mores and traditions for its perpetuation. Mathematics helps not only in the formation of laws but also in their compliance. In fact the harmony, law and order and dynamicity prevailed in our society are all because of Mathematics. The world transaction, exchange, commercial trade and business depend on Mathematics. The means of transport, communication and the so many scientific inventions and discoveries that have knitted the world into a family owe their existence to Mathematics.

Mathematics is not confined to the classroom or school only. Its utility is very comprehensive and wide. It has an important bearing on various aspects of life beyond the school. Therefore, it is desirable at the part of the teacher to make the references regarding its use in actual life, while teaching the mathematics. The students should be explained the utilitarian and cultural values of mathematics in practical life.

5) Evaluation through formal and informal methods

Evaluation is defined as a process of collecting evidences of behavioral changes and judging the directions and extents of such changes. This means that evaluation is free neither from instructional objectives nor from the teaching learning. In fact, it is intimately related to objectives and learning activities on the one hand, and improvement of instructions on the other.

Types of Evaluation:

Formative Evaluation
The goal of formative Evaluation is to monitor student learning to provide ongoing feedback that can be used by instructors to improve their teaching and by students to improve their learning. More specifically, formative Evaluations:
- help students identify their strengths and weaknesses and target areas that need work
- help faculty recognize where students are struggling and address problems immediately

Formative Evaluations are generally low stakes, which means that they have low or no point value. Examples of formative Evaluations include asking students to:
- draw a concept map in class to represent their understanding of a topic
- submit one or two sentences identifying the main point of a lecture
- turn in a research proposal for early feedback

Summative Evaluation
The goal of summative Evaluation is to evaluate student learning at the end of an instructional unit by comparing it against some standard or benchmark. Summative Evaluations are often high stakes, which means that they have a high point value. Examples of summative Evaluations include:
- a midterm exam
- a final project
- a paper
- a senior recita

Continuous and Comprehensive Evaluation

Continuous and comprehensive evaluation is an education system newly introduced by Central Board of Secondary Education in India, for students of sixth to tenth grades. The main aim of CCE is to evaluate every aspect of the child during their presence at the school. This is believed to help reduce the pressure on the child during/before examinations as the student will have to sit for multiple tests throughout the year, of which no test or the syllabus covered will be repeated at the end of the year, whatsoever.

6) Problems of Teaching

Following four problems are deemed to be the core areas of concern:

1. A sense of fear and failure regarding mathematics among a majority of children,
2. A curriculum that disappoints both a talented minority as well as the non-participating majority at the same time,
3. Crude methods of assessment that encourage perception of mathematics as mechanical computation, and
4.   Lack of teacher preparation and support in the teaching of mathematics.

Other Systemic Problems

One major problem is that of **compartmentalisation**: there is very little systematic communication between primary school and high school teachers of mathematics, and none at all between high school and college teachers of mathematics. Most school teachers have never even seen, let alone interacted with or consulted, research mathematicians. Those involved in teacher education are again typically outside the realm of college or research mathematics.

Another important problem is that of **curricular acceleration**: a generation ago, calculus was first encountered by a student in college. Another generation earlier, analytical geometry was considered college mathematics. But these are all part of school curriculum now. Such acceleration has naturally meant pruning of some topics: there is far less solid geometry or spherical geometry now.

Gender Issue: Mathematics tends to be regarded as a 'masculine domain'. This perception is aided by the complete lack of references in textbooks to women mathematician.

7) Error analysis and related aspects of learning and teaching

The purpose of error analysis are to

1) identify the patterns of errors or mistakes that students make in their work
2) understand why students make the errors, and
3) provide targeted instruction to correct the errors.

When conducting an error analysis, the teacher checks the student's mathematics problems and categories the errors. Errors in mathematics can be factual, procedural, or conceptual, and may occur for a number of reasons.

Common Student Challenges

The first step of error analysis is to correctly identify the specific errors displayed in students work. First, let's look at a few reason why students may make errors.

Lack of knowledge. Students' lack of knowledge could be a major reason why they cannot solve certain problems consistently.

Poor attention and carelessness. Other possible causes of student error are poor attention and carelessness. To address this issue, teachers should first consider the alignment between the instruction, student ability, and the task.

Identification of students' specific errors is especially important for students with learning disabilities and low performing students. By pinpointing student errors, the teacher can provide instruction targeted to the student's area of need. In general, students who have difficulty learning math typically lack important conceptual knowledge for several reasons, including an inability to process information at the rate of the instructional pace, a lack of adequate opportunities to respond (i.e., practice), a lack of specific feedback from teachers regarding misunderstanding or non-understanding, anxiety about mathematics, and difficulties in visual and/or auditory processing.

8) Diagnostic and Remedial Teaching

The main aim of diagnostic evaluation is to determine the causes of learning problems and to formulate a plan for remedial action.

The definitions of a diagnostic test as given by different educationists are as follows :

"A test that is sharply focused on some specific aspect of a skill or some specific cause of difficulty in acquiring a skill, and that is useful in suggesting specific remedial actions that might help to improve mastery of that skill is a diagnostic test." - Thorndike.

"A diagnostic test is developed to identify specific strengths and weakness in basic skills such as reading, and arithmetic." - Stadola and Stordahl

"Diagnostic tests are primarily concerned with the skills or abilities that the subject matter experts believe are essential in learning a particular subject." - Mehrens.

"A diagnostic test undertakes to provide a picture of strengths and weaknesses."
- Payne.

A good diagnostic test will permit a pupil to demonstrate all aspects of the skill being measured and will pinpoint the types of errors that were made. A diagnostic test is a useful tool for analyzing difficulties but it is simply a starting point. Supplementary information concerning the physical, intellectual, social, and emotional development of the pupil is also needed before an effective remedial programme can be initiated.

In diagnostic testing the following points must be kept in mind:
i) Who are the pupils who need help?
ii) Where are the errors located ?
iii) Why did the error occur ?

The essential steps in educational diagnosis are:
i) Identifying the students who are having trouble or need help.
ii) Locating the errors or learning difficulties.
iii) Discovering the causal factors of slow learning

REMEDIAL INSTRUCTION : ITS MEANING

Diagnostic testing is a method of identifying the students who are experiencing learning difficulties. Remedial instruction or teaching helps in overcoming the difficulties due to instruction. It helps the students to be with the normal students in acquiring the common level of achievement.

The term 'remedial teaching' is generally used instead of remedial instruction by various educationists. The definitions are given below :

The dictionary meaning of the term 'remedial teaching' given by **Carter** is : "Remedial teaching means special instruction intended to overcome in part or in whole any particular deficiency of pupil not due to inferior general ability, for example, remedial reading instruction for pupils with reading difficulties ."

"Remedial teaching tries to be specific and exact. It attempts to find a procedure which will cause the child to correct his errors of the past and thus in a sense prevents future error." - **Yokam**.

SALIENT FEATURES OF REMEDIAL INSTRUCTION

1) Remedial instruction is a dynamic side of the diagnostic testing. Hence it depends on the educational diagnosis.
2) To overcome the difficulties in learning and in acquisition of skills is the main purpose of remedial instruction.
3) Remedial instruction is not only useful to cure the shortcomings but also in preventive measures.
4) Remedial instruction is a short term treatment.
5) Remedial instruction helps the below average students to be with the normal students in acquiring the common level of achievement.

The ultimate aim of diagnosis is to remove the weaknesses and difficulties of students. If some emotional or physical factors are responsible for the weaknesses, then efforts should be made to eliminate these factors with the help of concerned peoples. After eliminating the factors, remedial teaching should be done. The mathematics teacher may also prepare corrective material for this purpose. Thus, by remedial teaching the success can be achieved in removing the weaknesses of the student.
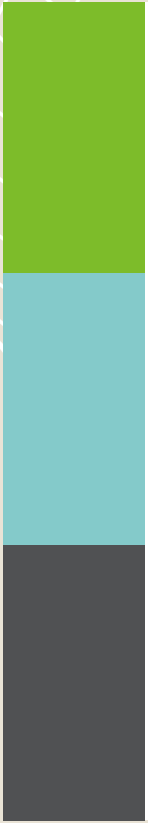
Chapter Three

NCF 2005 MATHEMATICS

NCF 2005 - Mathematics

According to the National Curriculum Framework (NCF) 2005, the main goal of Mathematics education in schools is the 'mathematisation' of a child's thinking. Clarity of thought and pursuing assumptions to logical conclusions is central to the mathematical enterprise. While there are many ways of thinking, the kind of thinking one learns in Mathematics is an ability to handle abstractions and an approach to problem solving.

The NCF **envisions** school Mathematics as taking place in a situation where:

1. Children learn to enjoy Mathematics rather than fear it
2. Children learn "important" Mathematics which is more than formulas and mechanical procedures
3. Children see Mathematics as something to talk about, to communicate through, to discuss among themselves, to work together on
4. Children pose and solve meaningful problems
5. Children use abstractions to perceive relationships, to see structures, to reason out things, to argue the truth or falsity of statements
6. Children understand the basic structure of Mathematics: arithmetic, algebra, geometry and trigonometry, the basic content areas of school Mathematics, all of which offer a methodology for abstraction, structuration and generalisation
7. Teachers are expected to engage every child in class with the conviction that everyone can learn Mathematics
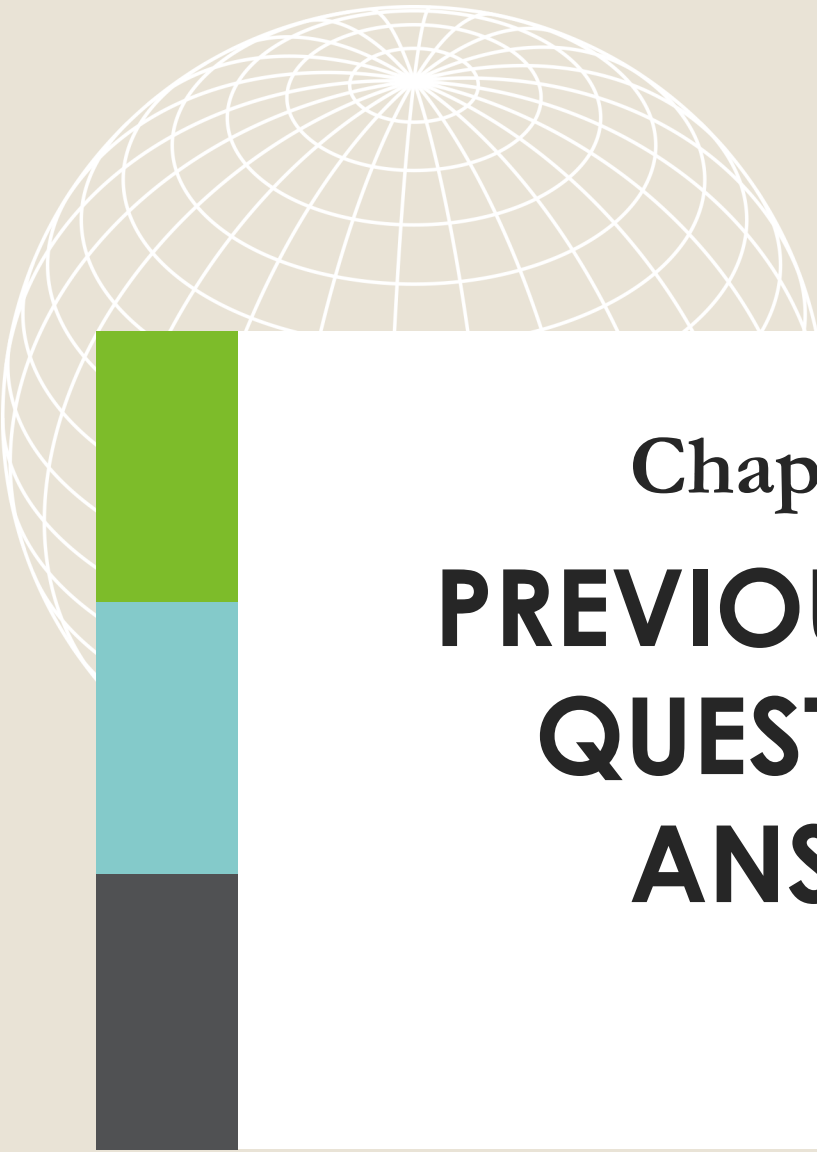
On the other hand, the NCF also lists the **challenges** facing Mathematics education in our schools as:

1. A sense of fear and failure regarding Mathematics among a majority of children
2. A curriculum that disappoints both a talented minority as well as the non-participating majority at the same time.
3 . Crude methods of assessment that encourage the perception of Mathematics as mechanical computation - problems, exercises, methods of evaluation are mechanical and repetitive with too much emphasis on computation.

4. Lack of teacher preparation and support in the teaching of Mathematics

5. Structures of social discrimination that get reflected in Mathematics education often leading to stereotypes like 'boys are better at Mathematics than girls. However the difficulty is that computations become significantly harder, and it becomes that much more difficult to progress in arithmetic.

The NCF, therefore, **recommends**:

1. Shifting the focus of Mathematics education from achieving 'narrow' goals of mathematical content to 'higher' goals of creating mathematical learning environments, where processes like formal problem solving, use of heuristics, estimation and approximation, optimisation, use of patterns, visualisation, representation, reasoning and proof, making connections and mathematical communication take precedence

2. Engaging every student with a sense of success, while at the same time offering conceptual challenges to the emerging Mathematician

3. Changing modes of assessment to examine students' mathematisation abilities rather than procedural knowledge

4. Enriching teachers with a variety of mathematical resources.

Chapter Four

PREVIOUS YEAR'S QUESTIONS & ANSWERS

QUESTIONS

Which principle is followed in the use of deductive method in teaching Mathematics? :
- A. Proceeds from unknown to known
- B. Proceeds from known to unknown
- C. Proceeds from particular to general
- D. Proceeds from general to particular

Which of the following is not an objective of teaching mathematics at primary level according to NCF 2005?
- A. Preparing for learning higher and abstract mathematics
- B. Making mathematics part of child's life experiences
- C. Promoting problem solving and problem posing skills
- D. Promoting logical thinking

According to the NCF 2005, which one of the following is not a major aim of Mathematics education in primary schools?
- A. To mathematisation of the child's thought process
- B. To relate Mathematics to the child's context
- C. To enhance problem solving skills
- D. To prepare for higher education in Mathematics

Which commission has explained about placing mathematics as a compulsory subject up to higher secondary?
- A. Hunter commission
- B. Kothari commission
- C. Mudakar commission
- D. The Universal Educational Commission

5 [Mathematics] [CTET-2016-09]

Some students of your class are repeatedly not able to do well in mathematics examinations and tests. As a teacher you would:
   A.   make them sit with high achievers
   B.   explain the consequences of ot doing well
   C.   give more tests for practice
   D.   diagnose the causes ad take steps for remediation

6 [Mathematics] [CTET-2016-09]

Which of the following is not a contributing factor responsible for mathematics anxiety?
   A.   Curriculum
   B.   Nature of subject
   C.   Gender
   D.   Examination system

7 [Mathematics] [CTET-2011-06]

The NCF (2005) considers that Mathematics involves 'a certain way of thinking and reasoning'. From the statements given below, pick out one which does **not** reflect the above principle:
   A.   The method by which it is taught
   B.   Giving students set formulae to solve the numerical questions
   C.   The way the material presented in the textbooks is written
   D.   The activities and exercises chosen for the class

8 [Mathematics] [CTET-2013-07]

According to NCF 2005 "Developing children's abilities for Mathematization is the main goal of Mathematics education. The narrow aim of school Mathematics is to develop 'useful' capabilities." Here mathematization refers develop child's abilities.
   A.   to develop the child's resources to think and reason mathematically, to pursue assumptions to their logical conclusion and to handle abstraction
   B.   in performing all number operations efficiently including of finding square root and cube root
   C.   to formulate theorems of Geometry and their proof Independently
   D.   to translate word problems into linear equation

9 [Mathematics] [CTET-2014-09]

As per NCF 2005, teaching of numbers and operations on them, measurement of quantities, etc. at primary level caters to the
- A. narrow aim of teaching mathematics
- B. higher aim of teaching mathematics
- C. aim to mathematise the child's thought process
- D. aim of teaching important mathematics

10 [Mathematics] [CTET-2011-06]

The purpose of a diagnostic test in mathematics is
- A. to fill the progress report
- B. to plan the question paper for the end-term examination
- C. to know the gaps in children's understanding
- D. to give feedback to the parents

11 [Mathematics] [CTET-2015-09]

Communication in mathematics class refers to developing ability to.
- A. interpret data by looking at bar graphs
- B. give prompt response to questions asked in the class
- C. contradict the views of others on problems of mathematics
- D. organise, consolidate and express mathematical thinking

12 [Mathematics] [CTET-2014-02]

As per the NCF, 2005.
- A. narrow aim of teaching Mathematics at school is to teach number system and higher aim is to teach algebra
- B. narrow aim of teaching Mathematics at school is to teach calculation and higher aim is to teach measurements
- C. narrow aim of teaching Mathematics at school is to develop numeracy-related skill and higher aim is to develop problem-solving skill
- D. narrow aim of teaching Mathematics at school is to that arithmetic and higher aim is to teach algebra

13 [Mathematics] [CTET-2016-09]

Which of the following is **not** an important aspect in 'algebra'?
- A. Generalization
- B. Visualization
- C. Measurement
- D. Transposition

14 [Mathematics] [OTET-2018-12]

What is the purpose of remedial teaching?
- A. Help students to overcome their learning difficulties
- B. Help teachers to develop proficiency in class-room management
- C. Help teachers to record learning difficulties of students
- D. Help teachers to take extra classes for satisfying the Headmaster

15 [Mathematics] [CTET-2014-09]

As per NCF 2005, one main goal of Mathematics education in schools is to
- A. develop numeracy skills
- B. enhance problem solving skills
- C. nurture analytical ability
- D. mathematise the child's thought process

16 [Mathematics] [CTET-2018-12]

To teach the Pythagoras theorem, a teacher has distributed a sheet on which four right-angled triangles were drawn and asks the child to find the relationship between the sides of a triangle. In the above situation, the teacher used:
- A. inductive method
- B. deductive method
- C. lecture method
- D. laboratory method

17 [Mathematics] [CTET-2014-09]

As per the vision statement of NCF 2005, School Mathematics does not takes place in a situation, where children
- A. learn to enjoy Mathematics
- B. see Mathematics as a part of their daily life experience
- C. pose and solve meaningful problems
- D. memorise formulae and algorithms

18 [Mathematics] [CTET-2011-06]

When introducing mensuration, a teacher writes all the formulae on the board before proceeding further. This reflects that she is following the.
- A. Inductive approach
- B. Deductive approach
- C. Experimental approach
- D. Practical approach

19 [Mathematics] [CTET-2013-07]

A very common error observed in addition of linear expression is 5y + 3= 8y. This type of error is termed as.
- A. Clerical error
- B. Conceptual error
- C. Procedural error
- D. Careless error

20 [Mathematics] [CTET-2015-02]

Place of mathematics education in the curricular framework is positioned on twin concerns:
- A. What mathematics education can do to improve the score of students summative examination and how it can help to choose right stream in higher classes
- B. What mathematics educationcan do to improve communication skills of every child and how it can make them employable agter school
- C. What mathematics education can do to engage the mind of every student and how it can strengthen the student's resources
- D. What mathematics can do to retain every child in school and how it can help them to be self-dependent

ANSWERS

Q.NO	ANS	Q.NO	ANS	Q.NO	ANS	Q.NO	ANS	Q.NO	ANS
1	D	2	A	3	A	4	B	5	D
6	C	7	B	8	A	9	A	10	C
11	D	12	C	13	C	14	A	15	D
16	A	17	D	18	B	19	B	20	C

Chapter Five

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CONCLUSION

That's enough theory – let's get on with the practice. Login to preptoz.com for more questions.

An ounce of practice is generally worth more than a ton of theory.

-E F Schumacher, Small Is Beautiful: A Study of Economics as if People Mattered

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